

Claims

What is claimed is:

1. A method of forming an inorganic macroporous material on a substrate exhibiting substantial periodicity, the method comprising the steps of:

providing a colloidal crystal template on a substrate comprising organic polymer particles;

introducing into the interstitial voids of the colloidal crystal template a noncolloidal inorganic precursor composition;

forming a hardened inorganic structure from the noncolloidal inorganic precursor; and

removing the colloidal crystal template from the hardened inorganic structure to form an inorganic macroporous material on a substrate.

2. The method of claim 1 wherein the colloidal crystal template is comprised of organic polymer particles.

3. The method of claim 1 wherein the organic polymer particles are spheres.

4. The method of claim 3 wherein the organic polymer particles comprises polystyrene, polymethylmethacrylate, or a fluorinated polymer.

5. The method of claim 3 wherein the organic polymer particles comprises surfactant on the surface.
6. The method of claim 5 wherein the surfactant comprises sodium dodecyl sulfate.
7. The method of claim 5 wherein the surfactant fuses the organic polymer particles together.
8. The method of claim 1 wherein the noncolloidal inorganic precursor composition comprises an inorganic precursor dissolved in a solvent.
9. The method of claim 8 wherein the solvent comprises an alcohol.
10. The method of claim 9 wherein the alcohol is anhydrous ethanol.
11. The method of claim 8 wherein the noncolloidal inorganic precursor composition comprises an alkoxide.
12. The method of claim 11 wherein the alkoxide comprises titanium(iv) isopropoxide, titanium(iv) ethoxide, titanium(iv) butoxide, titanium(iv) tert-butoxide, titanium(iv) methoxide, or titanium(iv) propoxide.
13. The method of claim 11 wherein forming a hardened inorganic structure from the noncolloidal inorganic precursor comprises allowing the alkoxide to condense.

14. The method of claim 1 wherein removing the colloidal crystal template from the hardened inorganic structure comprises calcining the organic polymer particles.
15. The method of claim 1 wherein the inorganic macroporous material comprises titania in nanocrystalline anatase form.
16. The method of claim 1 wherein the step of introducing the noncolloidal inorganic precursor into the interstitial voids of the colloidal crystal template comprises subjecting the noncolloidal inorganic precursor and the colloidal crystal template on a substrate to a gravitational force.
17. The method of 16 wherein the gravitational force is applied by centrifugation.
18. The method of claim 1 wherein the inorganic macroporous material exhibits a photonic stopgap.
19. The process of claim 1 wherein the substrate comprises glass, indium tin oxide coated glass, fluorine doped tin oxide, silicon wafer, quartz, or mica.
20. The method of claim 1 wherein the inorganic macroporous material exhibits a high quality three-dimensional periodicity on a substrate.
21. The method of claim 1 wherein the inorganic macroporous material exhibits a refractive index of at least 2.5.